Table of Contents

	Page
Purpose	3
Executive Summary	4
Introduction	5
Research and Development Opportunities in Edmonton	11
Facilities	30
Financing Programs	35
Edmonton Research and Development Park	41
Quality of Life	42
Conclusion	45
Sources of Assistance	46
References	47

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Prepared by:

Edmonton Economic Development Authority
1983

Tables

	Page
1. Gross Expenditures in Canada on R&D by Performing Sector 1975 - 1982	6
2. R&D Expenditures in the Business Sector by Selected Industries 1975 - 1982	7
3. Federal Government Research Expenditures by Department 1975 - 1982	8
4. Federal Establishments' R&D Expenditure by Province or Region 1980	8
5. Expenditures of Provincial Research Organizations 1977 - 1981	9
6. Sample of Edmonton Based Microelectronics Firms	20
7. University of Alberta Research – Selected Faculties	25
8. University of Alberta Research – Income by Source	25
9. University of Alberta Enrolment by Faculty – Winter Session 1982 - 83	29
10. University of Alberta Engineering and Science Faculties' Academic Staff by Department	29
11. A Sampling of Edmonton Laboratory Equipment Suppliers	31
12. University of Alberta Selected Degrees Granted by Faculty 1981	32
13. Northern Alberta Institute of Technology Enrolment 1981-82	32

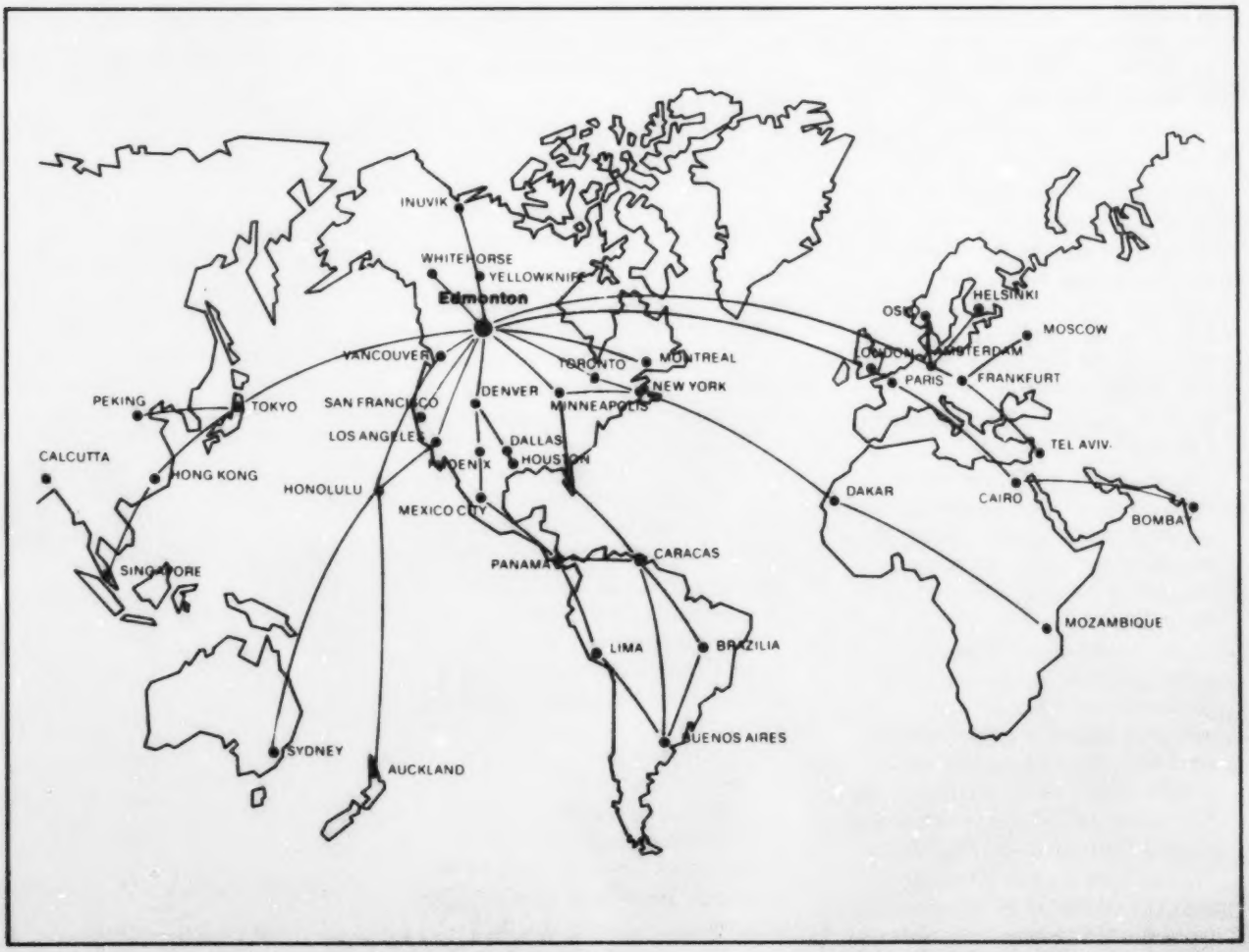
Graphs

1. Total Expenditures on R&D in Canada	5
2. Business Expenditures on R&D by Sector	7
3. Gross Expenditure on R&D as a Percentage of GNP	9

Purpose

This report examines the location factors important for siting a research facility and Edmonton's ability to meet those needs. Business decision makers must determine if their research operation can be enhanced by establishing facilities for a new research project in Edmonton or moving an existing research group to Edmonton. The contents of this report will provide much of the information required to make that decision.

Edmonton, Alberta in the world.



Executive Summary

This report provides the justification for an extensive examination of Edmonton as a location for research facilities.

During 1982, $4.3 billion was spent on research and development in Canada. Canada's gross expenditure on research and development as a percentage of GNP (1.2%) is ninth in the world. It has become a national goal to increase research spending to 1.5% of GNP.

Edmonton is a logical location to conduct research.

- Already located in Edmonton are major research spenders (1982 figures) such as: Syncrude Research ($17.5 million), Sherritt Research ($4.9 million), the University of Alberta ($37.8 million) and the Alberta Research Council ($19.5 million).
- Alberta leads the world in the technological development of sour gas and synthetic oil, construction in colder climates, and some aspects of transportation technology.
- There are 30 microelectronics manufacturers in Edmonton. A major telecommunications research facility is Bell-Northern Research, with 78 employees. A CAD/CAM system installed at the University of Alberta is one of the most advanced in the world.
- Professional staff and technical support staff may be hired locally from the University of Alberta (21,000 students) and the Northern Alberta Institute of Technology (4,900 students).
- Because of the demands of researchers already here, Edmonton has a well developed scientific equipment and supplies infrastructure. There are 160 suppliers of computer software.
- Research opportunities exist here for world markets such as medical research or local resource development like oil sands, agriculture or soft woods. Edmonton manufacturers ship $5.8 billion in goods annually.
- The University of Alberta library gives researchers access to 2,000,000 volumes plus 15,000 periodical subscriptions.
- Numerous financial incentives are available to companies carrying out research activities from federal government programs, provincial government funding agencies, and the Edmonton Research and Development Park.
- The Edmonton Research and Development Park offers favourable lease and purchase terms to research facilities and is conveniently located for access to transportation, housing, the university and the central business district.
- The Alberta provincial government is committed to encouraging more research in the province. They have established a venture capital company ($240 million) and a medical endowment fund ($300 million) to further that end.
- Edmonton offers an excellent quality of life with extensive recreational activities, culture, schooling and housing.

The Edmonton Economic Development Authority welcomes the opportunity to provide more information to businesses considering an Edmonton location.

Introduction

The term "high technology", is being increasingly used by industry and the public. Significant technological advances of the 1970's will continue into the next century because of the resources now directed towards research. Importantly, current and future advances are not restricted to the microelectronics field. Since microelectronics and high technology are often treated synonymously, this report examines the much broader field of research and development.

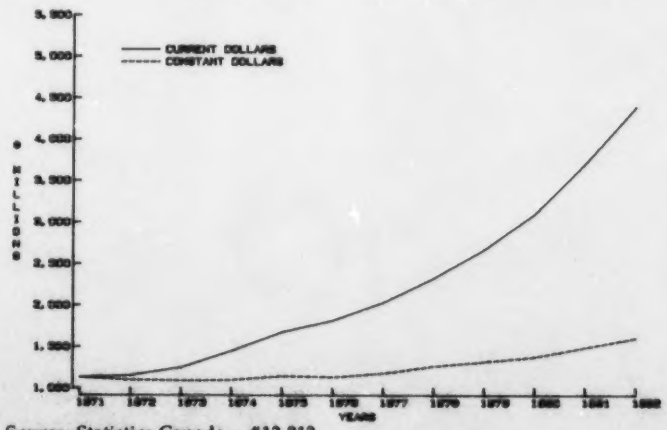
Research and development work has been defined by the OECD (Organization for Economic Co-operation and Development):

> Research and experimental development comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

This activity can be further classified as one of basic, applied or developmental. Basic research is that undertaken to advance scientific knowledge; applied research works towards a specific practical application; developmental uses the results of applied or basic research to create new or improve existing materials, devices, products or processes.

In Canada, an estimated $4.3 billion was spent on research during 1982. Businesses performed 53% of that amount, federal and provincial governments 26%, and higher education institutions 21%.

Graph 1 **Total Expenditures on R&D in Canada**



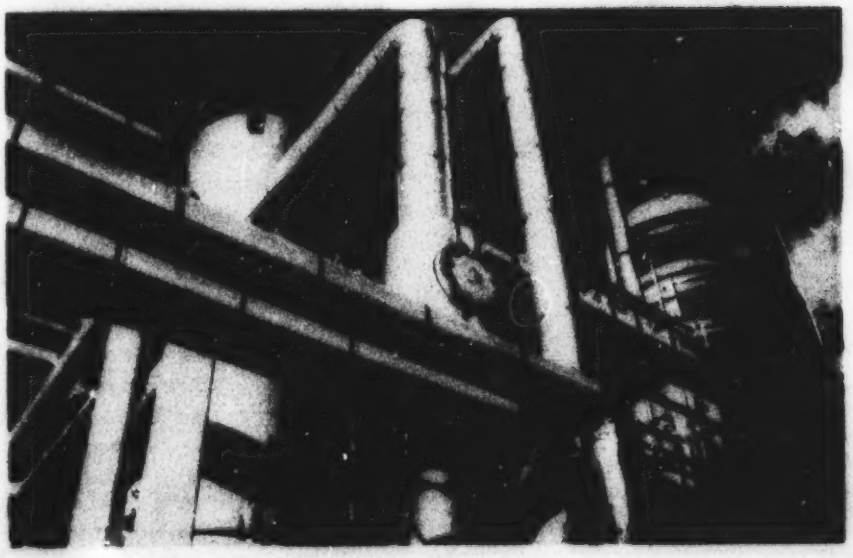
Source: Statistics Canada – #13-212

Table 1
Gross Expenditures in Canada on R&D by Performing Sector 1975 - 1982

Year	Federal Government	Provincial Governments	Business Enterprise	Higher Education	Private Non-Profit	Total
$ Millions (current dollars)						
1975	472	61	700	432	12	1,675
1976	500	70	755	476	13	1,814
1977	546	77	857	534	16	2,030
1978	626	84	1,007	588	19	2,324
1979	629	100	1,273	646	21	2,669
1980	714	123	1,500	733	27	3,097
1981[p]	829	132	1,895	820	30	3,707
1982[p]	979	148	2,309	919	35	4,390
$ Millions (1975 dollars)[1]						
1975	472	61	700	432	12	1,675
1976	457	64	689	435	12	1,657
1977	466	66	731	456	14	1,732
1978	502	67	803	472	15	1,864
1979	457	73	925	469	15	1,940
1980	469	81	986	482	18	2,035
1981[p]	495	79	1,131	490	18	2,213
1982[p]	530	80	1,251	498	19	2,378

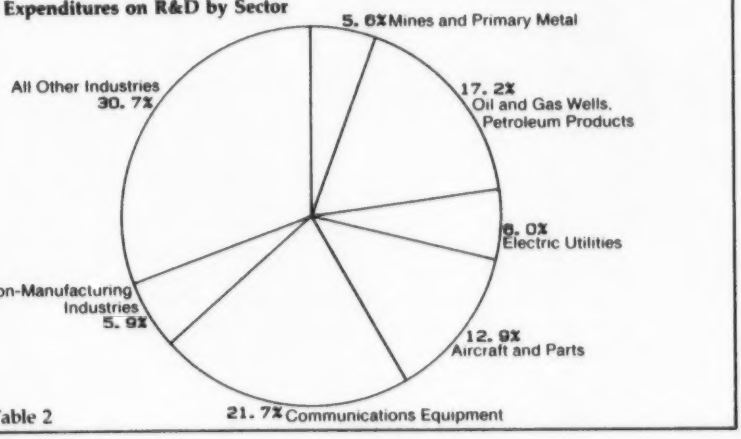
[1] Based on the implicit price index of the GNE.
[p] Preliminary
Source: Statistics Canada – #13-212

Canadian research expenditures in the business enterprise sector are concentrated in communications equipment (21.7%), gas and oil wells, petroleum products (17.2%), and aircraft and parts (12.9%). The top 70 spenders in the private sector account for 50% of the spending.



Edmonton's oil, gas and petrochemical industries make extensive use of high technologies for extraction and production.

Graph 2
Business Expenditures on R&D by Sector


5. 6% Mines and Primary Metal
17. 2% Oil and Gas Wells, Petroleum Products
8. 0% Electric Utilities
12. 9% Aircraft and Parts
21. 7% Communications Equipment
Other Non-Manufacturing Industries 5. 9%
All Other Industries 30. 7%

Source. Table 2

Table 2
R&D Expenditures in the Business Sector by Selected Industries 1975 - 1982 ($ millions)

Industries	1975	1976	1977	1978	1979	1980	1981[r]	1982[r]
Mines & Primary Metals	75	81	74	84	100	136	142	129
Gas & Oil Wells, Petroleum Products	79	75	107	136	213	237	367	398
Food, Beverages & Tobacco	25	30	29	32	36	40	44	49
Wood based Industries	31	35	36	36	53	65	83	99
Business Machines	19	19	19	24	34	49	60	78
Other Machinery	42	37	42	43	55	63	67	82
Aircraft and Parts	57	72	95	131	153	171	247	299
Other Transportation Equipment	15	16	21	23	33	37	47	55
Communications Equipment	128	137	147	171	217	260	336	500
Other Electrical Products	29	28	30	34	46	59	60	74
Drugs and Medicines	25	27	29	32	40	47	53	64
Other Chemical Products	44	48	48	54	66	80	89	109
Other Manufacturing Industries	39	41	41	47	58	66	79	98
Electrical Power Utilities	42	46	44	56	69	76	99	138
Other Non-Manufacturing Industries	50	63	95	104	100	114	122	137
Total	700	755	857	1,007	1,273	1,500	1,895	2,369

Source: Statistics Canada – #13-212

Table 3
Federal Government Research Expenditures by Department 1975 - 1982 ($ millions)

Department	1975	1976	1977	1978	1979	1980	1981[r]	1982[r]
Agriculture	108	107	115	126	143	153	171	200
Atomic Energy of Canada Ltd.	58	60	57	68	64	69	82	95
Energy, Mines & Resources	42	48	55	66	64	82	105	133
Environment	102	106	106	50	60	77	88	108
Fisheries and Oceans	–	–	–	57	50	52	57	55
National Defence	45	54	62	61	59	72	74	82
National Research Council	70	81	89	102	112	129	157	200
Other	47	44	62	85	77	80	95	106
Total	472	500	546	626	629	714	829	979

Source: Statistics Canada – #13-212

Table 4
Federal Establishments' R&D Expenditure by Province or Region 1980

	$ Millions	Per cent of total
British Columbia	42	5.9
Alberta	41	5.7
Saskatchewan	21	2.9
Manitoba	44	6.2
Ontario	104	14.6
National Capital Region	339	47.5
Quebec	48	6.7
Atlantic Provinces	76	10.6
Total	714	100.0

Source: Statistics Canada – #13-212

Federal spending by department shows Agriculture and the National Research Council as having the highest expenditures. Those federal expenditures are predominantly in the National Capital Region.

The largest spender of the provincial research organizations is the Alberta Research Council headquartered in Edmonton.

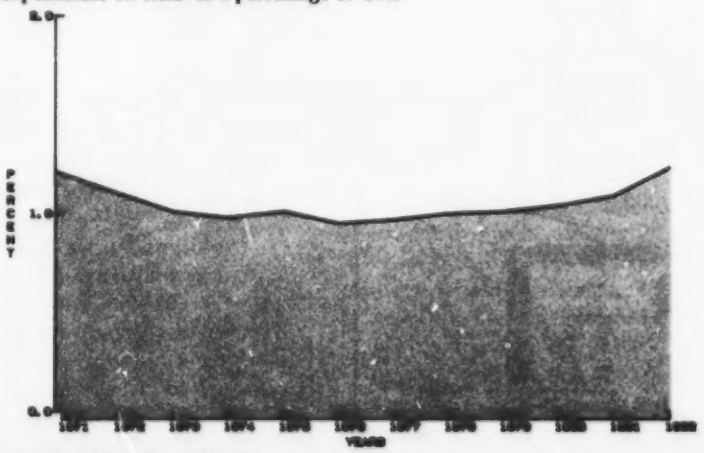
Table 5
Expenditures of Provincial Research Organizations 1977 - 1981
($ millions)

	1977	1978	1979	1980	1981
British Columbia Research Council	4	4	5	6	7
Alberta Research Council	13	14	21	23	29
Saskatchewan Research Council	5	6	6	8	8
Manitoba Research Council	1	1	2	3	4
Ontario Research Council	11	12	14	17	22
Centre de recherche industrielle de Quebec	7	8	10	12	14
New Brunswick Research and Productivity Council	2	3	3	3	4
Nova Scotia Research Foundation	2	3	3	3	4
Total	45	51	64	75	92

Source: Statistics Canada – #13-212

Despite these expenditures, Canada's gross expenditure on research and development as a percentage of GNP (1.2%) ranks ninth behind other industrialized countries. It is generally recognized that Canada must spend more on research. The Canadian government has asked that research expenditures increase to 1.5% of GNP by 1985.

Graph 3
Gross Expenditure on R&D as a percentage of GNP

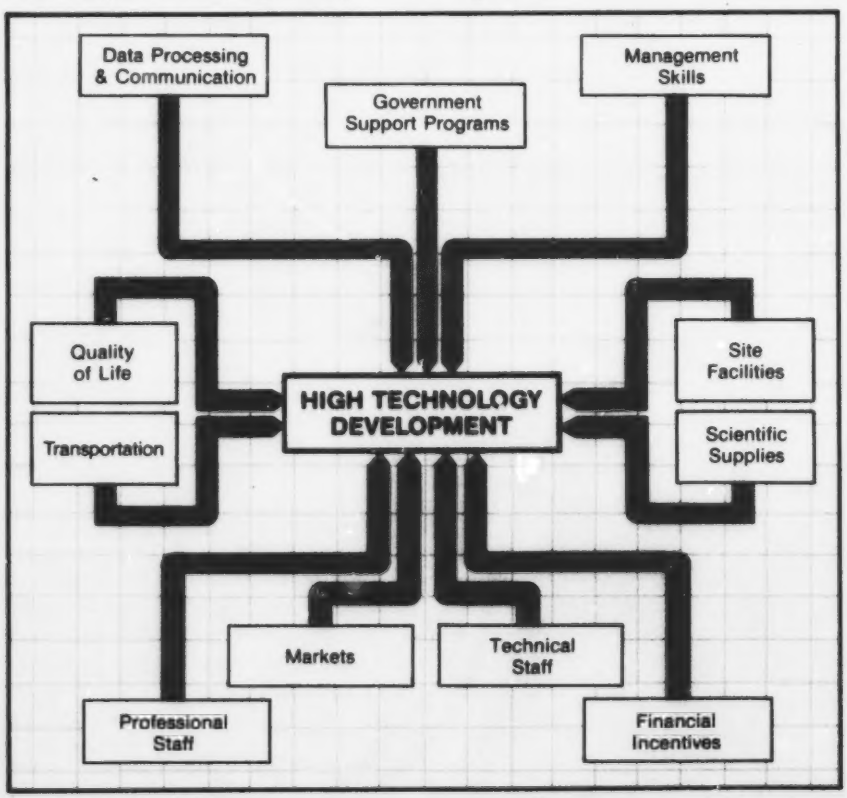


Source: Statistics Canada – #13-212

Increased research activities bring about greater economic growth, improved efficiency in production, a wider choice of products and better quality products. To achieve these objectives high technology development has become a national goal. Edmonton must be considered as one of the major centres in Canada for current and expanded research activities.

This report provides information that companies carrying on any aspect of research and development can use to assess Edmonton's ability to meet their location criteria. The Edmonton Economic Development Authority and the City of Edmonton recognize the importance of research and are committed to building major research facilities into the community infrastructure.

The factors to be considered in locating research laboratories are demonstrated by the accompanying diagram.



Research and Development Opportunities in Edmonton

There is increasing awareness that technological innovation and development is the cornerstone for future economic growth and prosperity. Investment of time, money and human resources in R&D activity today will have future payoffs.

This is as true for Alberta as it is for other parts of Canada, and the world. Although Alberta's economy is still primarily resource based, the future of both natural resource exploitation and of economic diversification lie in the development of new technologies.

Edmonton is the largest city in a region with vast resource potential: conventional oil and gas, oil sands, coal, agriculture and forests. Development of these resources has given rise to manufacturing and service industries which include: metal fabrication, petrochemical production, oil refining and food processing. Of $5.8 billion in Metro Edmonton manufacturing shipments in 1982, approximately $2.5 were petroleum and coal products. Another $1.1 billion of food and beverage products originated in Metro Edmonton.

In support of Edmonton's economy numerous research organizations have been established. Existing research is being supplemented with research in microelectronics, biotechnology and nuclear medicine.

All three levels of research (basic, applied, developmental) are carried out in Edmonton. Three major private research spenders in Canada are located here: Syncrude Research ($17.5 million in 1982), Sherritt Gordon Research ($4.9 million) and Alberta Government Telephones ($2.8 million). The University of Alberta received $37.8 million in research grants and contracts in 1981-82.

In recognition of the research potential in Alberta, Battelle Memorial Institute has formed a Battelle Alberta Technology Transfer Center and the Battelle Development Corporation of Canada, Ltd. in Edmonton. Battelle, a multi-national research organization with 7,100 scientists, engineers and supporting specialists worldwide, has its headquarters in Columbus, Ohio.

Battelle's plans for Edmonton include creating products and processes that Alberta industry can utilize. The Technology Transfer Center will also research products and create worldwide applications for products developed by Alberta firms via licensing arrangements.

The emphasis of Battelle will be to identify technologies which are economically viable and are of long-term benefit to Alberta. Possible areas of interest include oil sands research and, well into the future, mineral and mining technology, transportation, robotics and automation.

Medical and Biotechnology Research

The provincial government sees medical research as being an area of great opportunity for Alberta. To spur growth in this area, the Alberta Heritage Foundation for Medical Research was created in 1979. It has at its disposal a $300 million Medical Endowment Fund which supports an awards and grants program of: studentships, fellowships, major equipment grants and visiting scientists. The objective of the program is to develop a "critical mass" of scientists and research projects in Alberta. Of note is that funding is not strictly limited to basic medical sciences. Also supported is research in pharmacy, dentistry, clinical sciences, zoology, genetics, microbiology and biomedical engineering.

The Faculty of Pharmacy at the University of Alberta provides research leadership in bionucleonics and radiopharmacy. This involves the development and use of radioactive compounds for medical diagnosis and treatment. The Edmonton Radiopharmaceutical Centre is located on the university campus. This operation produces all of the radioactive diagnostic compounds required by Edmonton hospitals on a daily basis. Also located within the faculty is the Slowpoke Nuclear Reactor. The reactor is used by university researchers who require radioactive materials or who wish to do neutron activation analysis.

The chemistry department in the Faculty of Science is recognized as being one of the finest in Canada. An example of their research is the development of compounds for blood filtration and chemicals which eliminate the use of human blood in blood typing. These products have been commercialized for world-wide use by an Edmonton company – Chembiomed Ltd.

One of only two recombinant DNA laboratories in Canada is located within the genetics department at the University of Alberta. This laboratory is used for biotechnology research.

The Alberta Research Council recently announced several high technology joint research ventures. Among the areas identified as having significant potential is biotechnology. Results of biotechnology research include development of new cereal grains suited to the temperatures and soil conditions of western Canada.

Dr. R.E. Carter
Manager –
Research & Development
Energy & Resources
Canadian General
Electric Co. Ltd.

"We're inclined to think of big companies as moving slowly and taking a long time to change. In the case of the worldwide General Electric system, however, there's been a dramatic shift in the past decade. In 1970 our traditional electrical manufacturing business generated approximately three quarters of our revenue. By 1982 dependence on that end of the business had dropped to 40%. It's not that our electrical manufacturing activity is shrinking. Rather, other parts of the company, such as our service industries and materials companies, are growing at a much faster pace.

Canadian General Electric established its R&D Energy and Resources operation in Edmonton in 1981 as part of its strategic plan to diversify into the resource sector. This move reflects the Company's emphasis on technology and service based industries. Alberta was picked as our base because it was the fastest growing area in Western Canada. Edmonton in turn was recognized as having R&D strengths in the resource area.

Having spent all my professional life in the Company's R&D Laboratories, I was transferred to Edmonton to enlarge opportunities for CGE – either to develop new products or adapt existing products and technologies to the energy and resource sector.

One of the projects now under way involves modifying GE's hydraulic remote manipulator (Man-Mate) for use in the energy industry. Its principal application to date has been in foundries. We're testing it for oil and gas pipe handling and for other potential oilfield applications. Although GE has the world's largest line of electrical robots for

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manufacturing, greater lifting capacities are required in the resource industry. Extensive modifications are therefore required for oilfield use.

We're also working with the Alberta Forest Service and the Alberta Research Council to establish a program to develop a process to use Alberta's rich aspen resource. The process under investigation would produce a unique and marketable lignin. In conventional pulp plants the lignin is burned to produce steam and recover chemicals. To date two potential uses for this lignin have been identified – as an adhesive in the manufacture of chip board and as a feedstock for the synthesis of surfactants which are often used in tertiary oil recovery.

Although the economic climate in Alberta has changed since I arrived in Edmonton, causing us to put some of our plans on the back burner for the moment, I expect that in future we'll be setting up a sizeable R&D group here."

Dr. R.E. Carter
Canadian General
Electric Co. Ltd.

Energy Related Research

The problems of mineral resource extraction in Alberta offer unique and challenging opportunities for research and development with commercial potential. Both climate and recovery difficulties in extracting minerals (particularly oil and gas) are technical obstacles which when solved, will likely have worldwide commercial applicability.

One of the best examples of this is Syncrude, a consortium operating an oil sands mining and processing plant near Fort McMurray. Syncrude established its research facilities in Edmonton many years prior to construction of its oil sands plant. Ongoing research continues on improving the oil recovery process and on overcoming the numerous technical problems which arise over time.

The second largest community of researchers in the province work at the Alberta Research Council (ARC). The ARC employs 226 scientists and engineers, 195 technicians and 87 support staff. In 1982, the ARC received $19.5 million in contract research work.

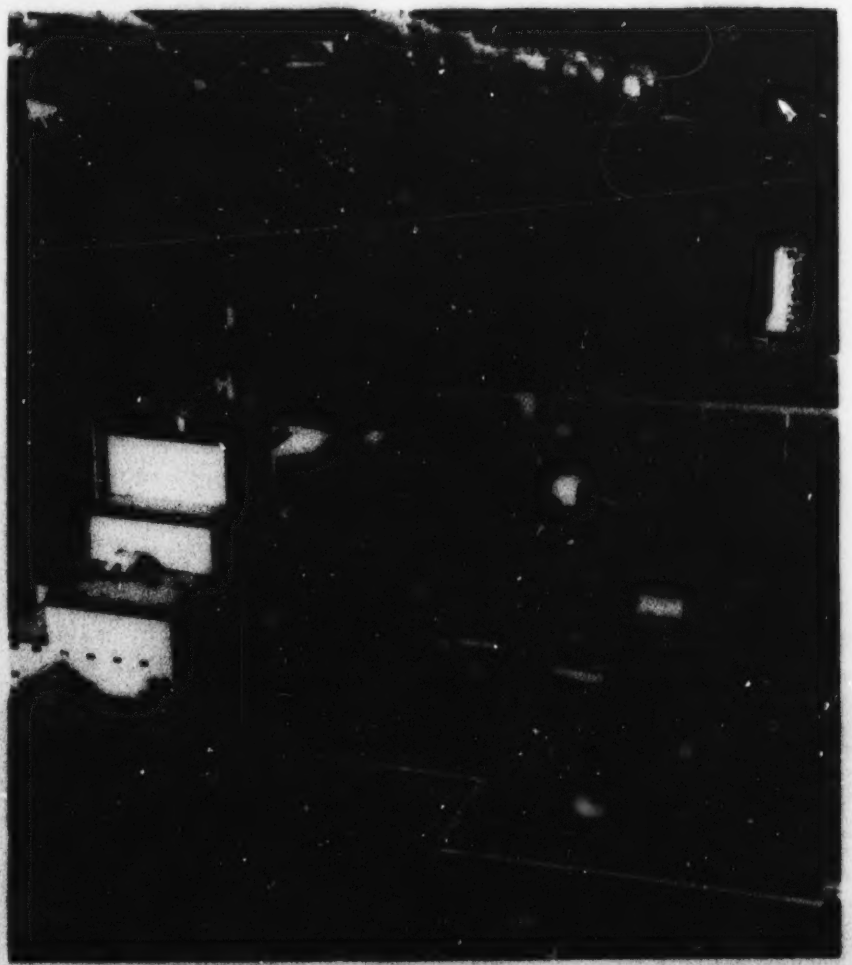
The mandate of the ARC since its inception in 1921, has been to provide scientific and technical support to industry and government in the province. The ARC has conducted research in diverse areas including development of the hot water process currently used to recover oil from the Alberta oil sands. Currently, the ARC focuses its capabilities in four areas: energy resources (oil sands, coal), environment, frontier sciences and industrial development.

Alberta has large bituminous and sub-bituminous coal reserves located on the eastern slopes of the Rocky Mountains west of Edmonton. Some of the coal is used to fire thermal power generating plants. The balance of coal production is destined for export to Pacific Rim markets and is of the metallurgical type. The Coal Mining Research Centre, the largest coal research centre in Canada, is to be located in a new facility just outside of Edmonton. The Centre is operated jointly by the Federal Department of Energy, Mines and Resources, the Alberta Research Council and the University of Alberta. Its purpose is to carry out research on coal mining techniques.

Research is also being conducted in the areas of coal gasification and liquefaction. These coal conversion processes will enhance the usefulness and marketability of Alberta coal. Due to the depth of coal deposits in the western region of the province, and the attendant difficulties in mining them, the insitu gasification of coal is being studied.

The energy sector, then, is a logical choice for research and development activity in Edmonton.

Applied and developmental research in coal, and non-conventional oil and gas is suitably located here because of both the market need and the expertise and research facilities already situated in Edmonton.



New and expanded high technology opportunities exist in coal mining, liquefaction and gasification as coal is re-emerging as a energy source.

Dr. Robert Schutte
Director,
Syncrude Canada Ltd., Research

"While the bulk of Syncrude employees work in Fort McMurray, there were good reasons for leaving our research department in Edmonton. Our facilities have been established here for many years and have recently been expanded; Edmonton can offer professionals the kind of environment that fits them; and finally, we feel it's a good idea to maintain some distance between an operating plant and a research lab. It allows us to look at the operation from a different perspective. After all, we're here to deal with long term problems, not with day-to-day 'firefighting'.

Syncrude has one of the largest private research labs on the prairies, employing close to 130. There are also another 55 or more Syncrude scientists and support staff working in environmental and geological research groups in the city.

Being in Edmonton allows us to maintain close contacts with the University of Alberta, particularly with the engineering and chemistry departments. We also have access here to the Alberta Research Council, to other members of the research community such as Athabasca Research, and to companies such as Sherritt Gordon and Dow, with whom we consult on matters such as metals analyses and analytical techniques. As well, the Chemical Institute of Canada is quite active here and many of our chemists and chemical engineers are involved.

Scientists and engineers tend to have active private lives and wide interests. We find they're attracted to Edmonton, where, for example, there are three professional theatres, an opera company that performs regularly, good schools for their children as well as a university where they can associate with like-minded people.

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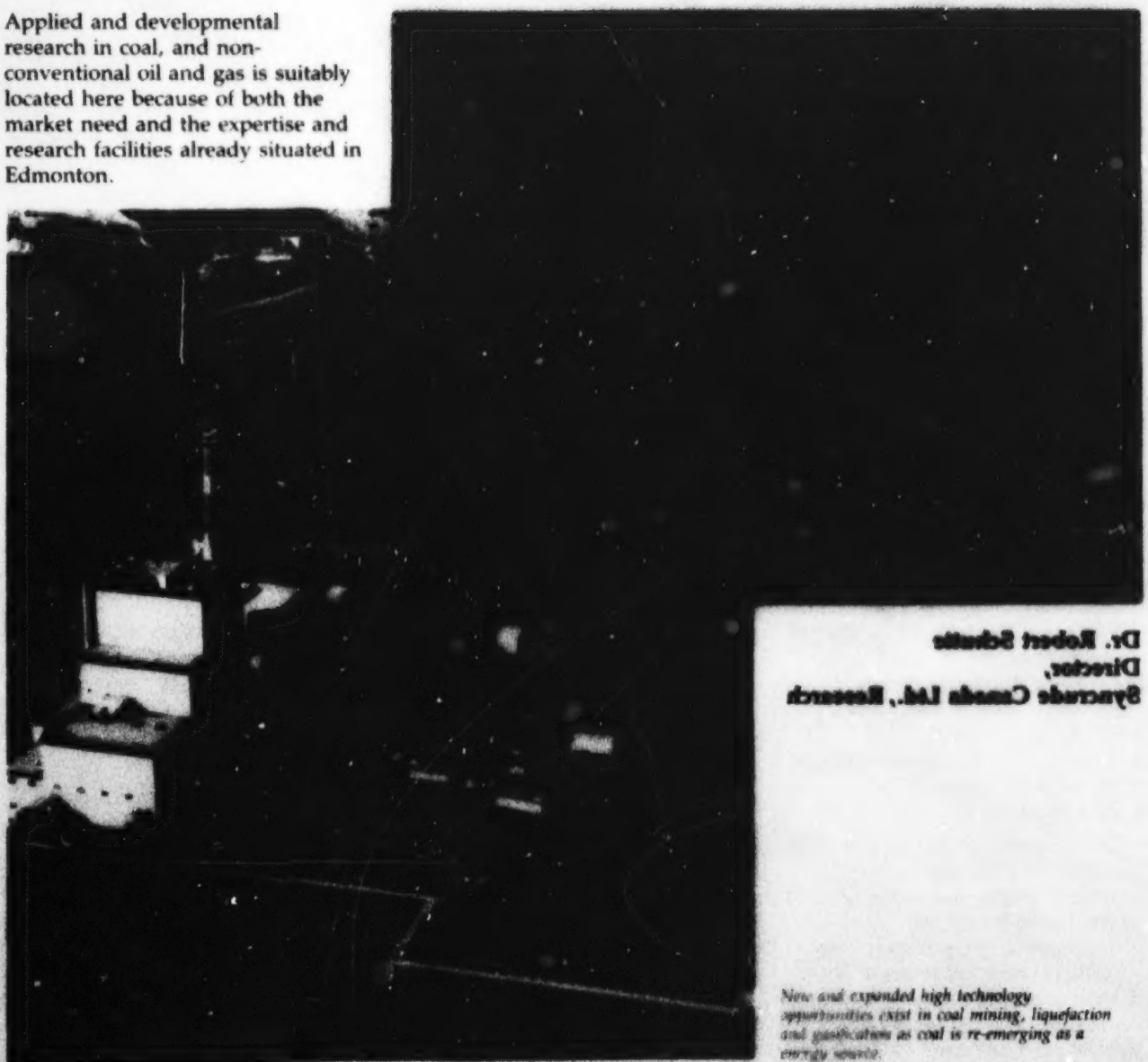

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At this lab, our research is highly applied. Current work revolves around mining equipment and its operation and improvements to our hot water extraction process, bitumen froth treatment and analytical methods. We're also involved in trying to upgrade the commercial catalysts we use in hydrotreating. And we're helping to define test methods for the private sector to use in relation to the vast amounts of rubber, plastics and metallic materials used in our tar sands operation.

In conjunction with Goodyear, our researchers have helped to develop rubber conveyor belts that can now withstand –60°C temperatures without cracking. This means savings of millions of dollars to the company. In other research, we've developed an on-line analyzer for tar sands. It's a remote sensing device, developed by adapting a U.S. instrument designed to spot oil slicks which allows us to measure the concentration of bitumen in tar sands. This is extremely important since every concentration requires that a different concentration of caustic soda be used.

I suppose there are some minor disadvantages to conducting research in Edmonton as opposed to in the Ottawa-Montreal-Toronto triangle where much of Canada's research community is concentrated. We can't attend as many technical workshops, for instance, and this tends to make us feel a bit isolated. But we try to overcome that by having more generous travel budgets than eastern companies.

A major expansion of the Syncrude research program was approved in February, 1981. We feel very strongly that this will produce greater financial rewards for the company. It's estimated the research we do here saves Syncrude four times what it costs to perform. As in other industries, the goal is to improve efficiency. In the face of the current price squeeze, better technology is the answer."

Dr. Robert Schutte
Syncrude Canada Ltd.,

Microelectronics and Telecommunications Research

In Edmonton since 1980, Bell Northern Research (BNR) moved its research operations and staff of 78 to its own $5 million facility located in the Edmonton Research and Development Park in the fall of 1982. BNR engages in both applied and developmental research relating to fibre optic systems for telecommunications, software components and overall communication systems planning. Plans are for future expansion of staff and new project undertakings.

The Alberta Microelectronics Centre is one of six such centres established in Canada by the Federal Government. Its purpose is to introduce microelectronics to production processes and products. The Centre offers lab facilities, consulting services, training courses, grant and funding applications, and manufacturing drawings and specifications.

Located on the University of Alberta campus, the Centre is able to offer computer facilities and expertise as required for product and system development.

Specific areas of research of interest to the centre are CAD/CAM systems, semi-custom chip design, unique sensors, and custom microprocessor based systems. For companies considering microelectronics in Alberta, the centre provides information on: state of the art technology, industrial microelectronic applications, financial assistance and funding, CAD/CAM and robotics applications, consultant and vendor contacts, partnership possibilities, and other services.

A new facility of special interest to those researchers requiring circuit board designs is the computer aided design installation at the University of Alberta. This system, one of the most advanced in North America, was installed at a cost of $2.7 million. It is located in the Electrical Engineering Department and is available to non-university users.

The system consists of a large number of graphics work terminals and software. The system allows users to develop and manufacture new microelectronic integrated circuits. Circuits can be constructed using a light pencil and video display system and then, through computer-aided manufacturing, a tiny chip for an integrated circuit can be produced for testing. New programs in microelectronics have been introduced at the university and world-renowned experts in microelectronics such as Dr. Henry Baltes, a leading authority on sensors, are now being attracted to the faculty.

Table 6 lists 30 electronics manufacturers that are located in the metro Edmonton area. These companies undertake research and

can provide electronic components for a wide variety of applications.

An example of one of these firms is Novatel Communications of which Alberta Government Telephones is a part-owner. Novatel Communications' purpose is to design, develop and market telecommunications systems for world markets. One product already developed is the AURORA automatic mobile telephone system.

With two Edmonton based telephone utiilities as potential customers, 'edmonton telephones' and Alberta Government Telephones, there is incentive for product innovation and development.

The Alberta Research Council is undertaking joint research on remote control equipment for use by the oil and gas industry.

The entire field of telecommunications has solid potential for research in Alberta because of the relatively long distances between population centres and the large number of remote installations which need frequent monitoring and controlling.

Table 6
Sample of Edmonton Based Microelectronics Firms

Organization Name	Research Areas	Contact Person
Alberta Microelectronic Development and Applications Centre	Work with industry on all phases of microelectronic product development	John Robson 432-3914
Andor Scientific Services Limited	Laboratory equipment repair and maintenance	Gerry Ramsey 451-1322
Athabasca Research Corporation Limited	Electronic wind and fluid flow tests	J.M. Kneesdi ,453-6151
Austec Electronics Limited	Radio tracking transmitters and receivers	L. Brokelsby 432-1878
Baker Engineering Enterprises Limited	Agricultural monitoring a.id control systems	Larry Hiller 463-0922
Bartronics (1972) Limited	Custom Manufacturing and systems assembly of electronics equipment	Raymond Barnes 455-6032
Bell-Northern Research	Fibre systems development, systems and network planning	Dr. A. Marsh 438-2666
Beta Electronics Limited	Sales and service of electronics products e.g. non-destructive test equipment	Frank McDonald Bruce McDonald 463-8363
Canadian Engineering Surveys Co. Limited	Electronic positioning services; integrated navigation systems; data collection systems	Barry Bishop 423-5929
Caulfield Engineering	Oceangraphic and electronic test equipment	David Caulfield 469-4177
A. Comeau and Associates Limited	Electrical engineering consulting development and production	D. Kelly 465-9961

Organization Name	Research Areas	Contact Person
Control Devices	Energy management and alarm control systems, remote meter monitoring system	Jack Brock 451-1440
Datek Industries Limited	Microcomputer based monitoring and control systems	P. Van der Zee
Digi-Sign Company Limited	Time/temperature displays, custom display products	L. Paquette 463-5901
Edmonton Compu-Draft Limited	Engineering documentation service bureau specializing in computer-generated artwork for printed circuit boards	P. Stephenson 459-1251
EID Systems Limited	Manufacturers automatic electronic identification-systems for road and rail vehicles	Howard Baldwin 484-7309
Harding Instruments Company Limited	Electronic engineering consulting and design services	Dale Allsopp 434-6434
Idacom Electronics Limited	Development and manufacture of electronic equipment to monitor, emulate and intercept/modify serial data	Bill Davis 438-2468
The Industrial Science Group	Satelite receiver systems, broadcast and communications equipment, medical electronics, non-destructive test equipment	Don Gillis 437-6687
Lakewood Engineering	Product development/engineering of computer based monitoring and control systems	Don Hilbka 462-9110 Jim Johansson 461-5114
Northern Telecom Canada Limited Transmission Group Headquarters	Optical fibre transmission systems, electronic multiplexing line carriers radio transmission	423-8020
Northwest Industries Limited	Aircraft maintenance, repair, modification, manufacture and assembly of electronic components and interconnecting cables	Bernard Bechtel 455-3161
Novatel Communications	Telecommunications systems engineering, installation and support	R. Betteridge 452-8450
The Sentron Group	Alarm equipment; electronics systems; clocks; intercom; manufacturing and services	Peter Goldring 437-5001
Siemens Electric Limited	Electronic products and systems to telecommunications manufacturing and service industries	H. Haloun 436-6640
Trison Instruments Limited	Specialized electronics manufacturing e.g. circuit boards	L. Tachuk 467-1644
Tundra Technical Industries Limited	Design, installation and maintenance of HFISSB radio communication systems, repeater systems; navigational packages	B. Parker 454-0788

Organization Name	Research Areas	Contact Person
Ultratech Systems Limited	Remote control and anti-theft devices custom design service for electronic and computer systems	Abe Liron 463-7742
Wellsdale Research Limited	Meteorological, hydrological and pollution equipment, manufacture, installation and maintenance	Robert Grausman 459-0380
Western Instruments Limited	Application equipment; thermocouples recorders; process control instrumentation electronics; custom design and fabrication	Alexander Palynchuk 456-6527

Source: Alberta Economic Development

Manufacturing and Construction Oriented Research

Given the mineral resource wealth in Western Canada, there are large economic gains to be made from their extraction and processing. This requires improved and more efficient recovery and processing of metal ores and natural gas. Development of new processes and refinement of existing ones will result from appropriate R & D activity, much of it undertaken by the private sector.

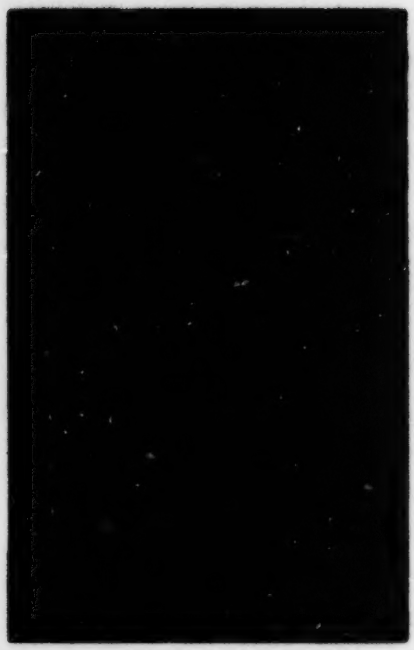
Sherritt Gordon Mines Ltd. operates a large nickel and cobalt refinery near Edmonton at Fort Saskatchewan. At the plant site the nickel is milled and made into numerous products including coinage blanks and coins. Some chemical byproducts that result from Sherritt's metal refining process are further processed into fertilizer at a recently expanded plant.

All of the processes used at the Sherritt plant have been developed by its research organization over the last 30 years. With an annual research budget of $4.9 million, the company has its research facilities located next to its Fort Saskatchewan plant. Central to Sherritt's continuing viability as a resource based manufacturer are its efforts to develop new products and branch into new market areas through applied and developmental research. To this end, an Edmonton presence has been highly conducive.

Also located in Fort Saskatchewan is Dow Chemical Canada which manufactures a variety of industrial chemical products including hydrochloric acid, ethylene compounds, and vinyl chloride. Dow also has a chemical research facility associated with its plant.

In recent years, extensive construction of major industrial plants has been undertaken in Edmonton and northern Alberta. Given the large temperature fluctuations during the course of a year, existing construction technology has to be modified so that it can cope with the demands imposed upon it. Syncrude, for example, has had numerous difficulties with its Fort McMurray plant during past winters. Over several years of operation, many of the problems have been solved, with the remainder still on Syncrude's research agenda.

The University of Alberta's Faculty of Engineering has staff and facilities to undertake aspects of cold weather research which are applicable to construction and operation of industrial plants.



Herbert Veltman
Director
Sherritt Research Centre
Sherritt Gordon Mines Limited

Sherritt Gordon Mines Limited is a medium sized Canadian metal mining, refining and manufacturing company with annual sales of around $300 million. Although our corporate head offices are in Toronto and our copper and zinc mines in Northern Manitoba, most of our other activities, including nickel and cobalt refining, metal fabricating and fertilizer production, are concentrated at Fort Saskatchewan, also the site of the Sherritt Research Centre.

For our size, I believe we have an unusually strong technology group. Of a total workforce of about 950 at Fort Saskatchewan, 130 people are involved in R&D or engineering related activity.

About 50% of our work involves providing technical assistance in the form of research, development, analytical and engineering services to our existing production plants. All of our processes and products require ongoing chemical and analytical work and the expansions which have been taking place here over the past several years require engineering work.

About one-quarter of our capacity is dedicated to corporate R&D on extractive metallurgical processes and development of new fabricated metal products. One of our aims is to convert our nickel and cobalt into higher value products as opposed to simply selling them as refined metals. These products include high tech materials such as special high temperature alloys, magnetic materials and special metal powders for a wide variety of industrial uses.

Another 25% of our activity involves R&D for technology sales. The process technology and engineering expertise initially developed for ourselves, is now in use also outside Canada in countries like Australia, South Africa, the Philippines and Finland.

With the help of technology developed here we're now also assisting others to recover gold from difficult ores. As well, we've recently developed a new concept in pressure hydrometallurgical technology which eliminates undesirable sulphur dioxide emission from zinc production. Instead, sulphur is recovered as a solid by-product in elemental form. The concept is already commercially used by two Canadian mining companies and further application of this technology is now being explored.

Sherritt's research group was originally located in Ottawa but was transferred here when our nickel refinery was built in the early 1950's. Sherritt was one of the first companies to be attracted to this area by then inexpensive natural gas

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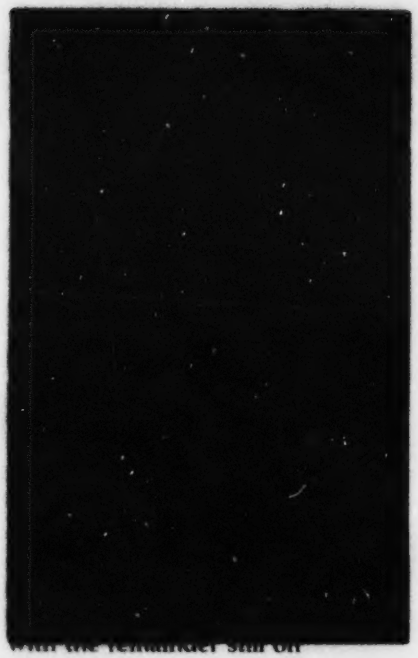

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plus other advantages such as the availability of land, water, railways and of course people. The research group followed as a natural extension. Today I think the infrastructure in the Edmonton area is such that it will attract research activities independent of manufacturing operations.

Over the years our research efforts have stimulated substantial business for Edmonton. People come from all over the world to learn how we handle certain problems and this often results in longterm benefits. When we're providing technological assistance to a client building a multimillion dollar project, for example, the relationship continues for many years."

Herbert Veltman
Sherritt Gordon Mines Limited

Table 7
University of Alberta Research – Selected Faculties

Faculty	Research Areas	"Contact Person
Agriculture and Forestry	The faculty of agriculture was established in 1915. A forestry program was added in 1970. Off-campus research facilities are operated by the departments of agricultural engineering, animal science, entomology, forest science, plant science and soil science.	Dr. J.P. Bowland Dean 432-4931
Engineering	The faculty of engineering is divided into five departments: chemical, civil, electrical, mineral and mechanical. The faculty has 93 permanent staff members. Added to its inventory of labs and equipment in 1982, was a $2.7 million computer assisted design (CAD) system.	Dr. Peter Adams Dean 432-3320
Pharmacy	A small faculty with 17 staff members, the faculty of pharmacy engages heavily in production of radioactive materials for medical diagnosis and testing. Research activity is concentrated on medical application of products from the Slowpoke nuclear reactor located on campus.	Dr. John Bachynsky Dean 432-3362
Science	Second only to the faculty of arts in staff and largest in student enrolment, the faculty of science is one of the University's strongest assets. Several departments, including chemistry, physics, microbiology, and genetics are among the best in Canada. Many of the staff are of international renown in their field.	Dr. W.J. McDonald Dean 432-4757
Office of Research Services	The office of research services maintains an inventory of principal investigators on campus that can be accessed by key word of area of interest.	Dr. J. Gordin Kaplin Vice President (Research) 432-5353

Table 8
University of Alberta Research – Income by Source
Contracted and Grants

Source of Income by Order of Magnitude

	Amount	% of Total
1. Federal Government Departments & Agencies	$16,960,821	44.8
2. Provincial Government Departments & Agencies	14,049,901	37.1
3. Associations, Foundations, Institutes, etc.	4,643,553	12.3
4. Business & Industry	1,385,523	3.7
5. Others	/327,008	.9
6. United States Government	133,771	.4
7. Other Governments or Government Agencies	153,827	.4
8. Individuals	104,488	.3
9. Municipalities, Schools and Counties	75,672	.2
	$37,834,564	100.0

Source: University of Alberta – Report of the Governors 1981-82

University Research

The focus of basic research in Edmonton is the University of Alberta.

Established in 1908, the University has a long history of research. It has enjoyed substantial funding that has made possible the attraction of high calibre staff and the purchase of sophisticated equipment. About 80% of the research funds at the university are spent on basic research with the balance directed towards applied research. Particularly strong in scientific research are the faculties of Engineering, Pharmacy and Science.

Some achievements of the Engineering faculty have been in medical laser equipment, oil sands recovery processes, enhanced recovery of conventional oil and structural engineering.

The University of Alberta, with an academic staff of 2,700, is a centre for public and privately funded research.

Dr. P.F. Adams
Dean,
Faculty of Engineering
University of Alberta

"Although a substantial amount of basic research is conducted at the University of Alberta, the emphasis in the faculty of engineering is on applied research. The goal is to create a climate favourable to intelligent industrial development and this includes producing people who will be of benefit to industry.

In order to accomplish this, we maintain day-to-day contact with the professional and industrial community. This close liaison has resulted in a variety of initiatives such as the co-operative undergraduate program which allows students to combine classroom study with practical experience in sponsoring companies; the computer engineering program, recently launched with support from the provincial government; and joint efforts, with the Alberta Construction Association, to develop a program in construction engineering. Programs at the graduate level, introduced in response to industry demand, include those in welding, oil sands and geotechnical engineering.

Of 120 full time teaching positions in this faculty, six are supported by funds from companies and agencies outside the university. Approximately 60% of the engineering staff is actively involved in research. Projects cover the spectrum from research on ice force problems experienced by artificial islands in the Beaufort Sea to the application of computers to process control at the Strathcona Refinery in Edmonton. Other research revolves around the testing of structural materials, the use of lasers in everything from medical procedures to welding operations and experimental work in energy conservation, transportation and aerodynamics. Current research on a glider model, for example, is of

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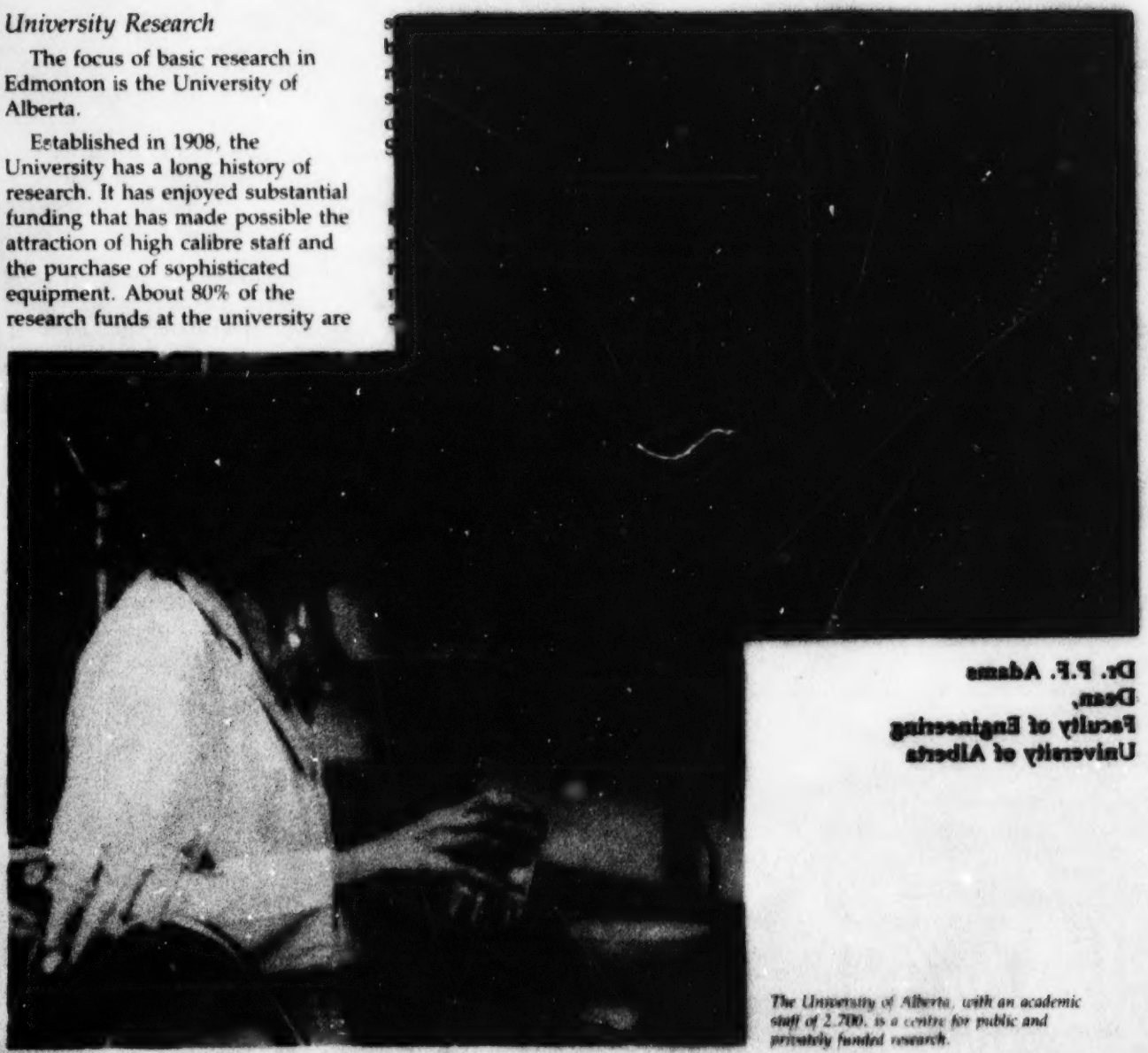

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particular interest because of the manufacturing potential.

Much of our research is supported by grants from agencies such as the Natural Sciences and Engineering Research Council which means that, with good researchers, you have a fairly free choice of projects. In the past five or six years, however, there has been growing emphasis on contract research, which now accounts for about 50% of our program. Government agencies or private companies contract with individual staff members to do certain research jobs. Often students involved in such research projects can transfer directly from the university to the sponsoring agency or company.

One of the major considerations for the university at the moment is how Alberta will move into the era of high technology. It appears the biggest opportunities lie in applying new technologies to areas in which we already have expertise — in the primary resource and medical fields, for example. The province has created an important pool of medical research and a mechanism will be needed to exploit the commercial aspects of that research. A combination of microelectronics and technology from the medical program could lead to significant manufacturing opportunities.

Edmonton may not yet be viewed primarily as a research centre. But I see definite signs that we are moving in that direction. If we can get people outside the research community to appreciate its value, Edmonton's prospects in this regard are very bright. The presence of the Alberta Research Council, the most significant force in Alberta research, the senior university and facilities such as the new Bell-Northern laboratory and the Coal Mining Research Centre at Devon are all major advantages. The addition in future of proposed northern research facilities would do much to strengthen Edmonton's base as a research centre."

Dr. P.F. Adams
Faculty of Engineering
University of Alberta

Table 9
University of Alberta
Enrolment by Faculty –
Winter Session 1982-83

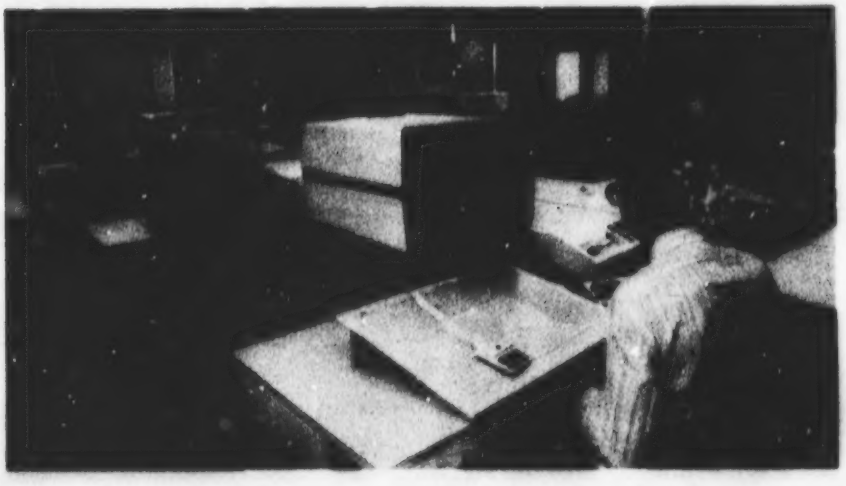
	Full-time
Agriculture & Forestry	618
Arts	3,490
Business	1,622
Dentistry	282
Education	3,245
Engineering	1,924
Home Economics	319
Law	512
Medicine	941
Nursing	465
Pharmacy	352
Physical Education	580
Rehab. Medicine	344
Saint Jean, College	286
Science	3,728
Graduate Studies & Research	2,302
	21,010

Source: University of Alberta

Table 10
University of Alberta Engineering and Science Faculties
Academic Staff by Department

Engineering –	Chemical	13
	Civil	29
	Electrical	26
	Mechanical	20
	Mineral	15
Science –	Botany	14
	Chemistry	40
	Computing Science	19
	Genetics	15
	Geography	24
	Geology	22
	Linguistics	7
	Mathematics	56
	Microbiology	10
	Physics	59
	Psychology	30
	Statistics	7
	Zoology	34

Source: University of Alberta – Faculty Calendars, various issues



Access to CAD/CAM technology is readily available to Edmonton's manufacturing and business community.

Facilities

Supplies

In response to the presence of a large university and the requirements of the oil industry, Edmonton has developed excellent laboratory supply facilities. Currently there are many laboratory supply houses of scientific requisites. Research organizations located here also state that special equipment fabrications can be readily obtained from an excellent selection of local trade shops (machine, welding, glass shops, circuits).

Testing facilities

There are a large number of testing laboratories available for obtaining test results and consulting. The "Directory of Chemical and Physical Testing Facilities" published by the Alberta Research Council lists 118 laboratories including government and education facilities. Most government labs will make their services and equipment available when tests cannot be done commercially.

Libraries

The largest library in the province, and that most often used by researchers, is the University of Alberta system. Contained within that library are 2,000,000 volumes and 15,000 periodical subscriptions.

Bibliographical computer searches are available through the Alberta Research Council to companies which do not have computer facilities. The ARC has access to data bases containing scientific and technical literature. The Alberta Research Council also operates three information centres: oil sands, coal technology, and SWERP (solar and wind energy). These centres catalogue and disseminate technical information about their respective subject areas.

Specialized supplies, like custom glass fabrication, are readily obtainable in Edmonton.

Table 11
A Sampling of Edmonton Laboratory Equipment Suppliers

Andor Scientific Services Ltd.
Caltec Scientific (Alberta) Ltd.
Canadian Institutional Furniture
Canlab Division of McGaw Supply Ltd.
Coulter Electronics of Canada Ltd.
Down Woods Ltd.
Fisher Scientific Co. Ltd.
Hewlett-Packard
IL International Canada Ltd.
International Ultrasonic Industries Ltd.
James International Sales Ltd.
Lab-Spec Industries Ltd.
Mandel Scientific Company Ltd.
Maynard Scientific
Nelson Machinery Company Ltd.
North American Scientific Chemical
Refractory Testing Laboratories Division of Ball Welding & Metallurgical & Engineering Ltd.
Sargent-Welch Scientific of Canada Ltd.
Tech-Met Canada Ltd.
Terochem Laboratories
Varian Canada Ltd.
Waters Scientific Ltd.

Professional Staff

The 1981 Census of Canada showed 7.6% of Albertans (127,119) over the age of 15 have a bachelor or graduate degree. Companies that wish to recruit professional staff locally will find well qualified candidates from the University of Alberta. Engineering and science faculties have earned a very high reputation within the research community. The faculty of Engineering is prepared to create programs in keeping with industrial requirements. For instance, masters level programs have been established in computer engineering, welding engineering and oil sands technology. The chemistry department is the second largest in Canada.

Table 12
University of Alberta
Selected Degrees Granted by Faculty
1981

Agriculture & Forestry	
BSc in Agriculture	94
BSc in Food Science	8
BSc in Forestry	40
BSc in Agric-Engineering	6
Engineering	
BSc in Engineering	345
Medicine	
BSc in Med. Lab. Science	19
Pharmacy	
BSc in Pharmacy	83
Science	
BSc (General)	296
BSc (Honors)	52
BSc (Specialized)	160
Graduate Studies and Research	
Master of Agriculture	2
Master of Engineering	15
Master of Science	152
Doctor of Philosophy	156

Source: University of Alberta – Summary of Statistics, 1982.

Technical Staff

The Northern Alberta Institute of Technology (NAIT), located in Edmonton, offers one year certificate and two year diploma programs. NAIT has a daytime enrolment of 4,900 students in 63 programs.

The accompanying table shows that NAIT is able to supply technologists to meet the requirements of most research organizations.

Table 13
Northern Alberta Institute of Technology
Enrolment 1981-82

Program	Enrolment
Civil eng. technology	912
Electrical eng. technology	667
Geological & Energy eng. technology	241
Mechanical eng. technology	324
Engineering Technologies	2,144
Health Science Technologies	526
Life Resource Technologies	358
Applied Arts Programs	154
Business and Commerce Programs	1,297
Service and Other Programs	442
Sub Total	**4,921**
Apprenticeship	10,821
Continuing Education	23,086
Total	**38,828**

Source: NAIT – In Perspective, 1982.

Computer Facilities

Edmonton has an established community of programmers, analysts, and data service bureaus. There are 160 such companies and 120 suppliers of equipment located in the city. Two of the larger installations in Edmonton are ACT Computer Services Ltd. with twin IBM S/370's and University of Alberta Computing Services with an Amdahl 470 V/7.

For companies that wish to transmit data, there are three suppliers of communication facilities: 'edmonton telephones', Altel Data, and CNCP Telecommunication.

Dr. Gerard Tertzakian
President
Raylo Chemicals Ltd.
Terochem Laboratories Ltd.

"As a producer of high technology specialty chemicals, our company is the exception rather than the rule in Canada. This country is very strong in the communications field, for example, but not in the specialty chemicals field. This is due in part to the lack of pharmaceutical research and manufacturing in Canada.

The chemicals we develop and sell to industry worldwide require a very high level of chemical expertise. And although there is strong competition in international chemical markets, hopefully our brain power will continue to make us competitive with countries where production is less expensive. To be a successful Canadian firm in this field, you have to be among the best. You can't be second class if you expect to make it against major producers such as West Germany and Japan.

Nothing we make is a consumer item. Our chemicals are used by industry in technologically advanced countries as building blocks for other products or in research and testing programs. Recently we've entered into the aerospace plastics business and have specialty high polymers in the experimental stage.

My own association with Raylo goes back a long way. I joined the company as a research chemist in 1966, moved into sales management when Raylo's production facilities were completed, then in 1971 launched my own company, Terochem Laboratories Ltd., to develop and manufacture specialty hard-to-make chemicals. In 1981, Terochem purchased Raylo and we transferred the bulk of our manufacturing operation to these facilities which also house four

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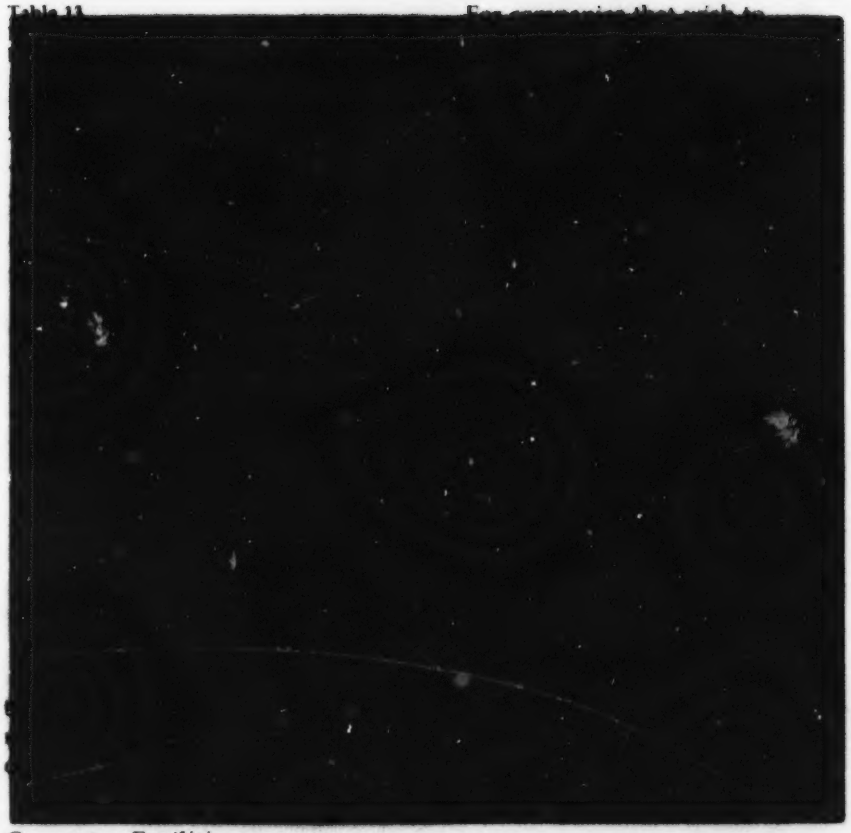

Computer Facilities

Edmonton has an established community of programmers, analysts, and data service bureaus. There are 160 such companies and 120 suppliers of equipment located in the city. Two of the larger installations in Edmonton are ACT Computer Services Ltd. with twin IBM S/370's and University of Alberta Computing Services with an Amdahl 470 V/7.

The chemicals we develop and sell to industry worldwide require a very high level of chemical expertise. And although there is strong competition in international chemical markets, hopefully our brain power will continue to make us competitive with countries where production is less expensive. To be a successful Canadian firm in this field, you have to be among the best. You can't be second class if you expect to make it against major producers such as West Germany and Japan.

Nothing we make is a consumer item. Our chemicals are used by industry in technologically advanced countries as building blocks for other products or in research and testing programs. Recently we've entered into the aerospace plastics business and have specialty high polymers in the experimental stage.

My own association with Raylo goes back a long way. I joined the company as a research chemist in 1966, moved into sales management when Raylo's production facilities were completed, then in 1971 launched my own company, Terochem Laboratories Ltd., to develop and manufacture specialty hard-to-make chemicals. In 1981, Terochem purchased Raylo and we transferred the bulk of our manufacturing operation to these facilities which also house four

"As a producer of high technology specialty chemicals, our company is the exception rather than the rule in Canada. This country is very strong in the communications field, for example, but not in the specialty chemicals field. This is due in part to the lack of pharmaceutical research and manufacturing in Canada.

development labs. The two operations employ about 46.

At Raylo we make lab scale products for sale as well as doing process development and contract research. For example, we're currently co-operating with the National Research Council to develop chemicals designed to disrupt the mating process of insects as a means of monitoring and controlling insect populations. The objective is to help farmers improve the timing and efficiency of their pesticide applications. Eventually this could reduce the amount of pesticides used on crops.

Although there are very few high tech chemical research and manufacturing facilities in Edmonton (Chembiomed is another), there are advantages to being here. The University of Alberta is an excellent resource centre and source of professionals. And primarily due to a demanding oil industry, we have a very good service sector in Edmonton. If we need glass blowing or welding done, for instance, we can count on fast service. I suppose a major disadvantage is our distance from markets which increases our communications and travel costs. As well, shipping costs can be a problem, in the case of low-value products particularly.

As chairman of the Chamber of Commerce high technology sub-committee, I'm involved in promoting Edmonton as a site for high tech industry and research. A nucleus of high tech industry creates a great demand for facilities and infrastructure. Assuming that all three levels of government play their cards right, Edmonton could become a significant research and high technology manufacturing centre over the next 20 years."

Dr. Gerard Tertzakian
Raylo Chemicals Ltd.
Terochem Laboratories Ltd.

Financing Programs

Federal Government

Federal Business Development Bank (FBDB) – The bank offers financial assistance to Canadian businesses through loan guarantees, equity financing and leasing. Also provides seminars, conferences and training courses designed to assist the management and operation of businesses in Canada.

There are a number of Federal Government programs that benefit companies engaged in research. Further information on current programs should be obtained from the sponsoring agency. The Edmonton Economic Development Authority will be pleased to obtain that information for interested companies.

Microelectronics Support Program (IRDP) – The program will contribute up to $10,000 towards feasibility studies and up to 75% of eligible costs to a maximum to $100,000 towards the incorporation, application or design of microelectronic devices in products or processes.

New Technology Employment Program (NTEP) – This program provides up to 75% of the wages, to a maximum of $290 per week per job, for the employment of highly educated graduates in science and technology who are unable to find employment in their disciplines. Employment will be in support of technological innovations in manufacturing, product and process development, and energy conservation. Maximum contribution per employer is $150,000.

Industrial Research Fellowships Program – This provides a maximum of $22,000 per year for three years to companies to employ a doctoral graduate in the natural sciences or engineering. Research Fellows are to be engaged in research, development or innovation activities.

Scientific Research Expenditures – Certain current expenditures may be deducted, which would otherwise not be permitted, when computing taxable income. Specifically, these are expenditures that are not incurred to directly produce revenue or expenditures that are of a capital nature.

Additional Income Tax Incentives

- a 50% additional deduction for increases in R&D expenditures above the average level for the 3 previous years (under review).
- investment tax credits, ranging from 10% to 25% for qualifying R&D; expenditures may be applied in full against income tax liabilities.

New proposals are being considered that will allow investors a 50% tax credit through R&D financing agreements under which corporations would renounce their R&D tax benefits in favour of the

investor. The 50% additional deductions may be replaced by a 10 percentage point increase in the rate of investment tax credits for R&D.

These incentives will make R&D spending more attractive to corporations and investors.

Industrial Research Assistance Program (IRAP) – Contributions to Laboratory Investigations – The Federal government will provide up to 75% of the costs incurred in contracting research to laboratories, institutes, or consultants. A maximum of three projects a year will be funded with a maximum cost of $6,000 per project. Applicants must have less than 200 employees.

IRAP – Contributions to Small Projects – This program is similar to the above except that the limit is $30,000 for 12 months to cover salaries and fringe benefits of professionals and technicians.

IRAP – Contributions to Large Projects – Funding is provided to hire staff or consultants necessary to bring a novel concept or invention to a stage where commercial development is feasible. Contributions will be made for up to 50% of project costs including salaries.

These applied research projects normally last two to three years. The amount of funding is dependent upon the total funds available and the number of competing projects.

Contracting Out: Science and Technology Program – The federal government plans to contract out its own research requirements to the private sector. They also will accept unsolicited research proposals in support of government scientific programs.

Defence Industry Productivity Program (DIP) – Contributions of 50% of costs, or more in special circumstances, are provided for research and development, prototypes, and evaluation of defence products with export potential.

Program for Industry/Laboratory Projects (PILP) – Funds are provided to Canadian companies to determine whether commercialization of research from the National Research Council is feasible. Agreements are for co-operative arrangements between the private sector and the federal government.

Industrial Research Associations – Up to $200,000 per year for five to seven years may be provided to industry supported associations that are formed to carry out research and development work on problems related to that sector. It is expected that the research association will become self sufficient.

Program for the Demonstration of Conservation and Renewable Energy – Demonstration projects, large and small, will be funded.

Dr. A.H. Marsh
Director,
Bell-Northern Research

"The Bell-Northern Research and Development lab in Edmonton is the key to our establishment of a high technology group in western Canada. We provide research and development for Northern Telecom's manufacturing plants in western Canada, especially in the area of transmission systems development and key telephone system design. We also offer telecommunications consulting services under contract to telephone companies, government and industry in the four western provinces.

The choice of Edmonton for the R&D facility wasn't automatic. There were several possible sites — but it was agreed that, on balance, Edmonton had the most to offer. The city is headquarters for two of Northern Telecom's major customers — Alberta Government Telephones and 'edmonton telephones', as well as headquarters for the Alberta Research Council, the largest western research entity of its kind. The University of Alberta has an excellent reputation and it's strong in the kind of disciplines, including electrical engineering and computer science, that we require.

I'm pleased to say we have been able to do most of our new hiring locally — from the university and from the Northern Alberta Institute of Technology. In general, recruiting here has not been difficult. Many westerners are well qualified to work in this kind of business, but to do so in the past they had to go east. Now they can work here on some state of the art projects.

A very important aspect of our lab is that we're working with fiber optics, a technology area that's going to grow dramatically over the next 10 years. We're on the threshold of major changes in telecommunications, as fiber optics gradually replace copper wire, and the kinds of skills and expertise we're building up in the lab here are very powerful. We are also investing heavily in the latest computer-aided techniques, which we are using for circuit pack and semi-conductor chip design.

Our $5 million facility, the first to be built in the Edmonton Research and Development Park, opened officially in June, 1983, with 78 employees. Staff is expected to reach 175 by the end of 1985 — and we have room to expand in future to house up to 500 people.

Edmonton already has a strong research orientation thanks to the ARC and the university but activity in the past has been heavily geared to agriculture and to the oil and gas industries. There isn't yet a large base of what we loosely call "high

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tech" — but it's growing. There are about 150 small Alberta companies in the electronics business and we're hopeful that Edmonton will become a significant high tech centre over the next four to five years. Certainly we've encountered no major disadvantages — at least none of a long term nature. It's quite possible to do high technology R&D efficiently in Edmonton.

A major advantage of being here is the "let's-get-it-done" attitude of Albertans. There's a real spirit of progress here, a feeling that no matter how tough the problem, it can be solved."

Dr. A.H. Marsh
Bell-Northern Research

Proposals that have the greatest potential for saving energy or developing renewable energy technologies will have funding preference.

Industry Energy Research and Development Program (IERD) – Grants of up to 50% of project costs will be provided to projects that may result in significant energy savings for wide applications in Canada.

Provincial Government

Vencap Equities Alberta Ltd. – During 1982 the government of Alberta created a new company to provide venture capital investments in high risk or innovative businesses. Equity will be provided to businesses involved in new technology areas such as biotechnology, microelectronics and chemistry.

The corporation has received a $200 million loan from the provincial government. A further $40 million will be raised through a public share offering. The government will not control the company but it reserves the right to buy a controlling 25% interest if the mandate of the company is not being followed.

Seven of the ine directors of Vencap Equities Alberta Ltd. are residents of Edmonton.

Alberta Oil Sands Technology and Research Authority (AOSTRA) – This organization, AOSTRA, was established by the Alberta government in 1974. They have made available $418 million for the purpose of developing new technology for the recovery and processing of petroleum from the Alberta oil sands, heavy oil deposits, and enhanced recovery from conventional deposits.

To date, funding has been provided to private sector research groups, universities, government research organizations, and individual researchers.

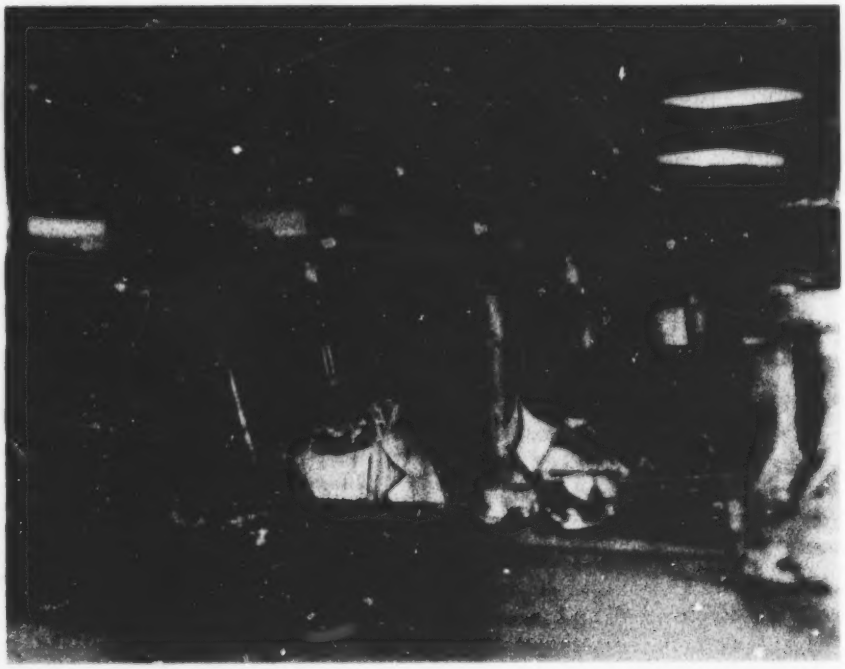
Alberta Heritage Foundation for Medical Research – This foundation, created in 1979, supports medical research in Alberta. Income from a $300 million endowment fund supports an awards and grants program of: studentships, fellowships, major equipment grants, visiting scientists, and others. The objective of this support is to develop a critical mass of medical researchers in Alberta to support the growth of highly qualified manpower in Alberta. Funding is not limited to basic medical sciences; also supported are researchers in pharmacy, dentistry, clinical science, zoology, genetics, microbiology, and biomedical engineering.

Alberta Opportunity Company – The Alberta Opportunity Company offers loans to small and medium sized Alberta businesses when

financing is not readily available through conventional sources. Preference is given to those providing new job opportunities, research and development, and promotion of Alberta products.

Alberta Research Council – High Technology Joint Research Ventures. The Alberta Research Council has funds available to conduct joint research ventures. ARC will share equally with the sponsor in funding projects up to $500,000 per year for four years. Further extensions may be possible. Licensing of any developments will be shared between the project sponsor and the Alberta Research Council. Research projects must fall into one of three areas: man/computer/machine interface, biotechnology, or chemical catalysts.

Alberta Agricultural – Farming for the Future, Nutritive Research Program. The provincial department of Agriculture offers grant programs in support of agriculture research. An example is the spending over the last few years of $1 million to successfully develop a new variety of honey bee better suited to Alberta's climate. Capital grants are also available for the construction of food research facilities.



Many forms of high technology research programs are eligible for provincial and federal government financial assistance.

Edmonton Research and Development Park

The Edmonton Research and Development Park was opened in 1981 to provide an attractive setting for the location of new research and development facilities. Located in south Edmonton, the Park offers convenient access to the International Airport, the university campus, downtown, and major highways. The current Park area comprises 64.75 hectares (160 acres) with an adjoining 64.75 hectares (160 acres) owned by the Alberta Research Council.

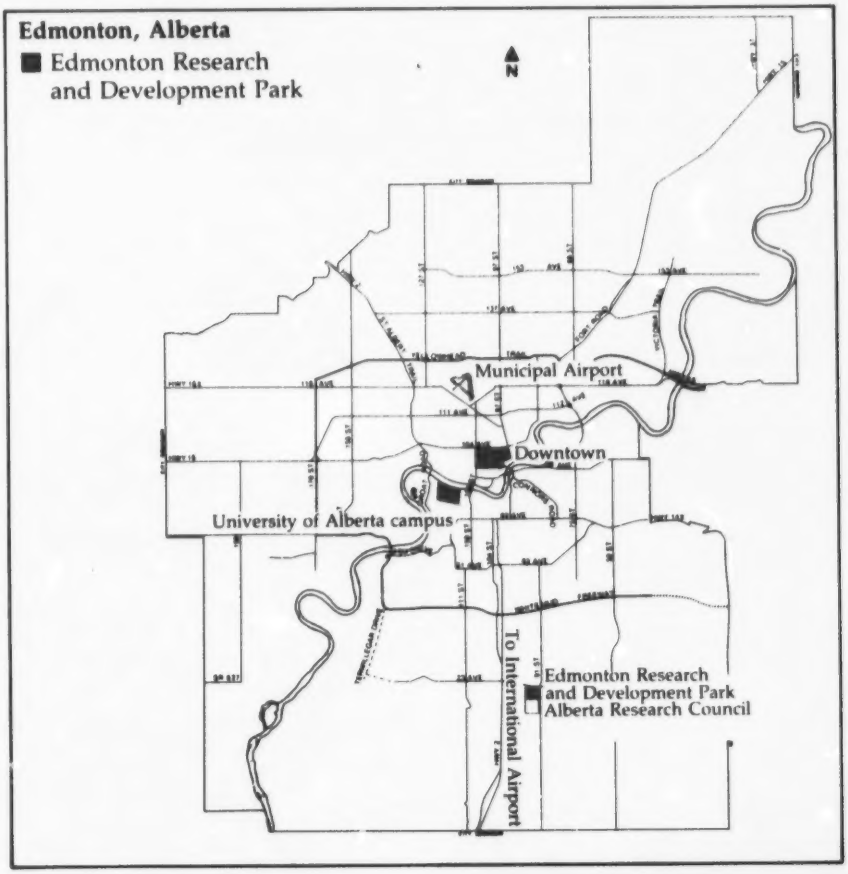
Land in the Park has been developed with a view to recovering the costs of such development only, and is accordingly priced very competitively. Services are provided for sewer, water, natural gas, power and roads. Land is offered either on long-term leases or sold to occupants outright. The Park will also build to suit individual tenants, or lease space in a Multi-Tenant Research building owned by the Research Park Authority.

The Park will provide a campus-like atmosphere for tenants. A planned core facility building will provide services to Park tenants such as a restaurant, travel agency, bank and health club facilities.

While research and development is the principal theme of the Park and all tenants will be expected to demonstrate minimum commitments in this area, a broad range of other activities are permitted, including prototype development, light manufacturing, marketing and administration.

Bell-Northern Research Ltd. (BNR) recently opened a $5 million, 4,300 square metre (46,000 square feet), laboratory in the park with 78 employees to conduct research and development work on fibre optics software for business telephone systems and telecommunications test systems. BNR plans to employ 250 people at its Edmonton location within the next five years.

The Alberta Research Council is constructing a 26,000 square metre (280,000 square feet) building adjacent to the park. Park tenants will have ready access to ARC's technical information service, scientists and laboratories.



Quality of Life

Culture

Edmonton has experienced dramatic growth in the variety and quality of cultural and entertainment attractions. The nationally acclaimed Citadel Theatre is one of several live theatre companies in the city. The Northern Alberta Jubilee Auditorium hosts performances by the Alberta Ballet Company, the Edmonton Opera and the Edmonton Symphony. Edmonton's Northland's Coliseum, with a seating capacity of 18,000, is the site of major sports, cultural and entertainment productions.

Since 1980, Edmonton has hosted SummerFest. This annual three month series of entertainment events features performances in music, dance, theatre and the visual arts. It concludes in August with the Edmonton Jazz Society's international festival, Jazz City.

Among other Edmonton attractions are numerous museums including the Provincial Museum and Archives, art galleries and the Edmonton Public Library's 12 branches.

With more than 300 restaurants offering a full range of dining experiences, Edmonton also has night spots providing for every taste.

Recreation

The Capital City Recreation Park extends along Edmonton's river valley for 16 kilometres (10 miles). The park contains a 55 kilometre (33 mile) trail system that connects the numerous recreational facilities located in the river valley.

These facilities include golf courses, swimming pools, tennis courts, boat launches, and picnic sites. Also available for public use throughout Edmonton are hockey rinks, golf courses, curling rinks, swimming centres, tennis courts, a velodrome and a shooting range.

In 1983, Edmonton hosted the XII World University Games. Several sports facilities have been constructed for the games, including an 11,000 seat indoor fieldhouse. The World University Games are second in size only to the Summer Olympics and are twice the size of the Commonwealth Games.

Edmonton is close to other major attractions, including Elk Island National Park and the famous Jasper and Banff National Parks. Within 160 kilometres (100 miles) of Edmonton are more than 50 lakes available for recreational use.

Sports

Edmonton has sport participation programs in hockey, football, soccer, skating, swimming, tennis, curling and baseball. Edmonton's community league system allows participation for any citizen who wishes to become involved. Edmonton is home to a number of professional sports teams: the

Edmonton Eskimos of the Canadian Football League, the Edmonton Oilers of the National Hockey League, the Trappers of the Pacific Coast Baseball League.

Housing

Edmonton offers all types of housing: apartments, duplexes, condominiums and single family dwellings. An additional feature is the availability of homes either in the city of Edmonton itself, in one of the neighbouring communities or on acreages in the countryside. Excellent road networks make commuting from any of these locations comparable in terms of convenience.

Climate

Edmonton has four seasons. Summers are warm, with daytime temperatures averaging 22°C (72°F) and evening temperatures cooling to a pleasant 15°C (60°F). Summer is complemented by a mild spring and autumn, as well as plenty of sunshine, making much of the year enjoyable for hiking, cycling, trail riding, golf, tennis and camping.

Winters are characterized by blue skies, low humidity and little wind. The coldest month is January, with the average high temperature being –10°C (14°F) and the average low being –18°C (0°F). With an average annual snowfall of 140 cm (55"), Edmonton is an ideal city for winter sport enthusiasts.

Transportation

Edmonton's two major commercial airports facilitate economic growth in the metro Edmonton area. The Edmonton International Airport located south of the city accommodates domestic traffic with direct service to 42 Canadian and 15 U.S. destinations and international air traffic to three European destinations. This airport is also a major marshalling point for freight, goods and services destined for the Northwest Territories and the Yukon. It also handles the specialized needs of passenger demand in the northwest sector of Canada.

Education

Edmonton offers excellent educational facilities. A broad choice of schooling is provided. An open boundary policy, combined with a variety of educational programs, allow pupils and parents to make considered decisions to meet individual needs. Special facilities include parochial schools, schools for the multiple handicapped and mentally handicapped and for children with learning disabilities.

The University of Alberta with an enrolment of over 21,000 full time students is Canada's third largest university. It offers post-secondary education with major faculties in arts, science, education, engineering, medicine, business and others (19 faculties in all) at the

bachelor's, master's and doctoral levels. Alternative post-secondary public educational facilities include the Northern Alberta Institute of Technology, one of Canada's largest technical institutes, offering 56 business, industrial and vocational programs; Athabasca University, which offers correspondence degree programs; and Grant MacEwan Community College, with four city campuses.

Health Services

Excellent health services are available in Edmonton. There are 3,876 hospital beds in the city's seven active treatment hospitals. A complete range of health services is offered by the Local Board of Health through ten regional health clinics. Edmonton has approximately 1,200 doctors listed with the College of Physicians and Surgeons of Alberta.

The Walter C. Mackenzie Health Sciences Centre opened in the spring of 1982. This $300 million medical complex provides patient care services as well as research and teaching facilities.

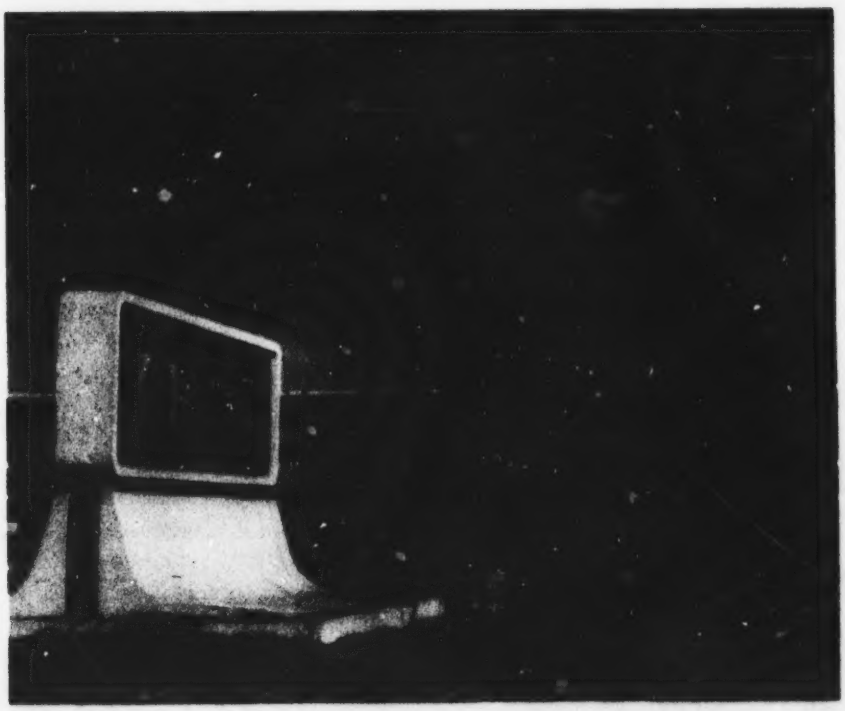
Special care treatment centres are also located in Edmonton. For example, the W.W. Cross Cancer Institute offers in-patient and out-patient cancer treatment.

Edmonton's park-like setting provides the backdrop to a very favourable quality of life.

Conclusion

If Canada is to achieve its economic potential, action must be initiated to develop indigenous technological capabilities. Alberta is clearly the focus of this economic potential and Edmonton as its capital city possesses enormous growth opportunities in the development of these new technologies. The federal, provincial and municipal governments are providing incentives to encourage growth in these areas. In addition to having these three levels of government represented in Edmonton, the city is also favoured by a strong university presence, research capability, industrial infrastructure, and a skilled work force. Recent initiatives by major research companies and organizations such as Hewlett Packard, the Battelle Memorial Institute and Bell-Northern Research provide strong testimony.

The Edmonton Economic Development Authority is ready to assist companies with information to evaluate Edmonton as a location for research facilities.



A number of international high technology firms have recently established an Edmonton presence.

Sources of Assistance

For further information on contacts and information contained in this report inquire to:

Edmonton Economic Development Authority
2410 Oxford Tower
10235 – 101 Street
Edmonton, Alberta T5J 3G1
Telephone: (403) 428-5464

These organizations can provide more information for companies considering an Edmonton research location:

Alberta Oil Sands Technology & Research Authority
500 Highfield Place
10010 – 106 Street
Edmonton, Alberta T5J 3L8
Telephone: (403) 427-7623

Alberta Research Council
7th Floor, Terrace Plaza
4445 Calgary Trail South
Edmonton, Alberta T6H 5R7
Telephone: (403) 438-5050

Association of Professional Engineers, Geologists and Geophysicists of Alberta
1010 One Thornton Court
Edmonton, Alberta T5J 2E7
Telephone: (403) 426-3990

Edmonton Chamber of Commerce
600, 10123 – 99 Street
Edmonton, Alberta T5J 3G9
Telephone: (403) 426-4620

Edmonton Research and Development Park Authority
1621 Canadian Commercial Bank Bldg.
10104 – 103 Avenue
Edmonton, Alberta T5J OH8
Telephone: (403) 428-9431

Alberta Heritage Foundation for Medical Research
1200, 10235 – 101 Street
Edmonton, Alberta T5J 3G1
Telephone: (403) 423-5727

University of Alberta
Vice President (Research)
University Hall
University of Alberta Campus
Edmonton, Alberta T6G 2E2
Telephone: (403) 432-5353

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